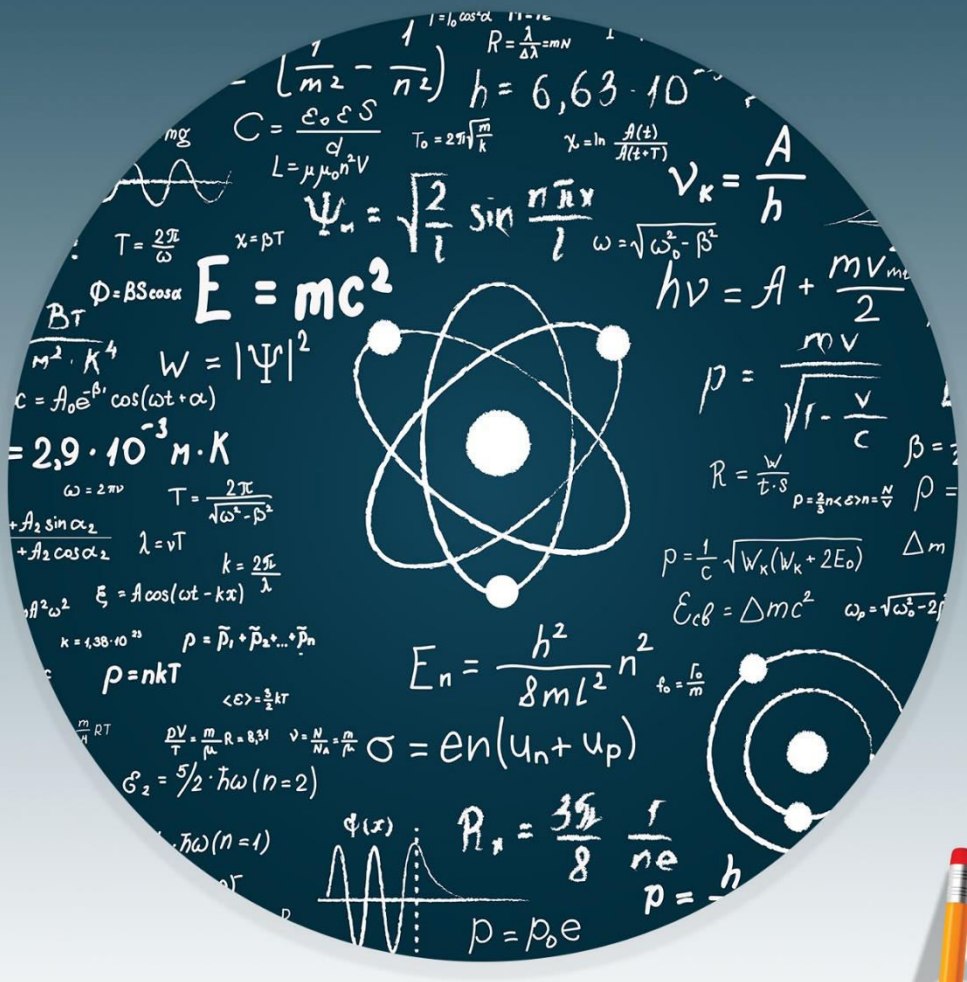
PHYSICS



WORKSHEET-18

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-18

Topics:- KMT, Pressure of Gas, Interpretation of Temperature, Internal Energy, Specific Heat Capacity

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Q.1 PV = RT Represent:

A) Gas equation for n moles

B) Gas equation for one mole

C) Gas equation for 10 moles

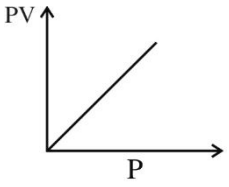
D) Gas constant for one molecule

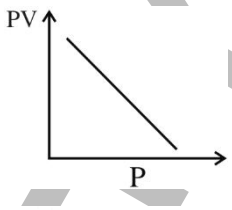
Q.2 The value of Boltzmann constant is:

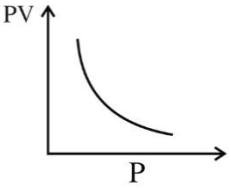
A) 13.8×10^{-23} J K^{-1} C) 13.8×10^{25} J K^{-1}

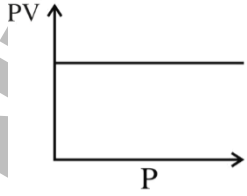
B) 1.38×10^{-23} J K^{-1} D) 1.38×10^{-25} J K^{-1}

Q.3 In an experiment to investigate the relationship between the volume *V* of a fixed mass of an ideal gas and its pressure *P*, a graph of PV against P is plotted. Which graph shows the correct relationship at constant temperature?

A) 

C) 

B) 

D) 

Q.4 Which of the following parameters does not characterize the thermodynamic state of matter?

A) Work C) Temperature

B) Pressure D) Volume

Q.5 Boyle's law is a relation between _____ thermodynamic parameters keeping temperature constant.

A) 1 C) 3

B) 2 D) ∞

Q.6 During an adiabatic expansion the increase in volume is

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associated with:

A) Decrease in pressure and decrease in temperature

B) Increase in pressure and decrease in temperature

C) Increase in pressure and increase in temperature

D) Decrease in pressure and increase in temperature

Q.7 In the expressions below, *R* is the molar gas constant, *P* is pressure, *T* is thermodynamic temperature, N_A is the Avogadro's number, *n* is the number of moles, *k* is the Boltzmann constant, and *m* is the mass one molecule of gas. Which one of the expressions is correct for the molar volume V of an ideal gas?

A) $\frac{RT}{P}$ C) $\frac{nRT}{P}$

B) $\frac{N_A RT}{P}$ D) $\frac{nkT}{P}$

Q.8 The internal energy of 1 mole of an ideal gas depends on:

A) Only volume

B) Only temperature

C) Only pressure

D) Temperature and pressure

Q.9 The mass of O_2 molecules is 16 times that of H_2 molecules. The rms velocity of O_2 molecules at room temperature is v_{rms}. The rms velocity of H_2 molecules at the same temperature will be:

A) 16 v_{rms} C) $\frac{v_{rms}}{4}$

B) 4 v_{rms} D) $\frac{v_{rms}}{16}$

Q.10 The internal energy of a monoatomic ideal gas is:

A) Translational K.E C) Rotational K.E

B) Vibrational K.E D) All of these

Q.11 The rms velocity for monoatomic gas is:

A) $\sqrt{\frac{3kT}{m}}$ C) $\sqrt{\frac{2kT}{m}}$

B) $\sqrt{\frac{8kT}{\pi m}}$ D) Zero

Q.12 **Internal energy is a unique function of state because change in internal energy.**

A) Does not depend upon path

B) Depends upon path

C) Corresponds to an adiabatic process

D) Corresponds to an isothermal process

Q.13 **How will it effect the pressure "P" of a gas such that average velocity of gas molecules is doubled?**

A) $P' = 4P$ C) $P' = P$

B) $P' = 2P$ D) Not possible

Q.14 **When we provide heat to a system then it's temperature?**

A) May rise C) May not change

B) May fall D) All of these

Q.15 **For which of the following process work done comes out to be maximum?**

A) Isothermal C) Adiabatic

B) Isochoric D) Isobaric

Q.16 **When heat is neither given nor taken from a system then it's temperature?**

A) May remain same C) May fall

B) May rise D) All of these

Q.17 **If temperature is increased from 200 K to 800 K then what would be the change in pressure at constant volume**?

A) Increases by factor 4 C) Decrease by factor 4

B) Increases by factor 2 D) Decreases by factor 2

Q.18 **The average translational K.E of molecules in a gas at temperature 27 °C is:**

A) 5.71×10^{-21} J C) 4.79×10^{-21} J

B) 7.54×10^{-21} J D) 6.21×10^{-21} J

Q.19 **The average speed of oxygen molecule in the air at STP is 461 m s^{-1}. For calculation of this speed the temperature is taken:**

A) 298 K C) 327 K

B) 273 K D) 25 °C

Q.20 **The direction of flow of heat between two bodies is determined by:**

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A) Internal energy C) Total energy

B) Kinetic energy D) None of these

Q.21 Universal gas constant of a gas is equal to:

A) C_p-C_v C) $C_p \times C_v$

B) C_p+C_v D) None of these

Q.22 20 °C will be equal to:

A) 50 °F C) 68 °F

B) 98 °F D) 100 °F

Q.23 If a gas is heated against a pressure, keeping the volume constant, then workdone will be:

A) Positive C) Zero

B) Negative D) Any of these

Q.24 Which of the following is the property of a system?

A) Pressure and temperature

B) Internal energy and entropy

C) Volume and density

D) All of these

Q.25 Which of the following quantity is not the property of a system?

A) Pressure C) Internal energy

B) Temperature D) Heat

Q.26 Work done in a free expansion (expansion in vacuum) process is:

A) Positive C) Zero

B) Negative D) Maximum

Q.27 Kinetic theory of gases assumes that the collisions between the molecules are:

A) Perfectly inelastic C) Partially inelastic

B) Partially elastic D) Perfectly elastic

Q.28 Temperature of a gas is due to:

A) Its heating value

B) Attraction of molecules

C) Kinetic energy of molecules

D) Potential energy of molecules

Q.29 An ideal gas as compared to a real gas at very high

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pressure occupies:

A) More volume C) Same volume

B) Less volume D) Unpredictable

Q.30 Which of the following variable/variables control the physical properties of an ideal gas?

A) Pressure C) Temperature

B) Volume D) All of these

Q.31 Heat and work are:

A) State functions C) Point functions

B) System properties D) Path functions

Q.32 A perfect gas at 30 °C is heated at constant pressure till its volume is double. The final temperature is:

A) 60 °C C) 606 °C

B) 333 °C D) 120 °C

Q.33 A piston cylinder contains air at 600 kPa, 290 K and a volume of 0.01 m^3. A constant pressure process gives 54 kJ of work out. The final volume of the air is:

A) 0.05 m^3 C) 0.15 m^3

B) 0.10 m^3 D) 0.20 m^3

Q.34 A gas is enclosed in a container fitted with a piston of cross sectional area 0.10 m^2. The pressure of the gas is maintained at 8000 Nm^{-2}. When heat is slowly transferred, the piston is pushed up through a distance of 4.0 cm. If 42 J heat is transferred to the system during the expansion, the work done by the gas is:

A) 52 J C) 48 J

B) 38 J D) 32 J

Q.35 Referring to previous question, the change in internal energy of the system is:

A) 4 J C) 6 J

B) 10 J D) 5 J

Q.36 Evidence in favour of kinetic theory of gases is exhibited in:

A) Diffusion of gases

B) Brownian motion of smoke particles

C) Both A & B

D) Macroscopic approach of gases

Q.37 Kinetic theory of gases is based on:

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A) Microscopic approach C) Molecular approach

B) Macroscopic approach D) Both A and C

Q.38 "Molecules do not exert force on each other" this postulate implies:

A) Gas molecules do not have K.E

B) Gas molecules have P.E

C) Gas molecules have very small mass

D) Gas molecules do not have P.E

Q.39 The momentum transferred to the walls of the container per second per unit area due to continuous collisions of molecules of the gas gives:

A) Force per unit area C) Pressure of gas

B) K.E of gas D) Both A and C

Q.40 The collision frequency of gas molecules in a cubical container is:

A) $\frac{2\ell}{v}$ C) $\frac{3v}{2\ell}$

B) $\frac{2\ell}{3v}$ D) $\frac{v}{2\ell}$

Q.41 If there are "N" no. of molecules each of mass "m" in a cubical container of volume "ℓ^3", then density of gas is given by:

A) $\frac{m}{\ell^3}$ C) $\frac{m}{N\ell^3}$

B) $\frac{M}{\ell^3}$ D) $\frac{mN}{\ell^3}$

Q.42 Referring to previous question, the no. of particles colliding with any face of cube are:

A) $\frac{N}{3}$ C) $\frac{N}{6}$

B) $\frac{N}{2}$ D) $\frac{N}{4}$

Q.43 A gas in a cubical container contains three molecules each having speed of 2 m s^{-1}, 4 m s^{-1} and 4 m s^{-1}.What is the root mean square speed?

A) $\frac{36}{3}\ m\ s^{-1}$ C) $6\ m\ s^{-1}$

B) $12\ m\ s^{-1}$ D) $\sqrt{12}\ m\ s^{-1}$

Q.44 Two gases A and B having the same temperature T,

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same pressure P, and same volume V are mixed, If the mixture is at the same temperature and occupies a volume V, the pressure of the mixture is:

A) P C) 2P

B) 4P D) 6P

Q.45 If P is the pressure of the gas, then the kinetic energy per unit volume of the gas is:

A) P/2 C) P

B) (3/2)P D) 2P

Q.46 H_2 and O_2 both are at thermal equilibrium at 600 K. Oxygen is 16 times heavier than H_2. Root mean square speed of Hydrogen is:

A) 4 times the root mean square speed of O_2.

B) $^1/_{16}$ times the root mean square speed of O_2.

C) $^1/_4$ times the root mean square speed of O_2.

D) 16 times the root mean square speed of O_2.

Q.47 The r.m.s speed of gas molecules having molar mass 'M' at a temperature 'T' is proportional to:

A) $\sqrt{M}$ C) $\frac{1}{\sqrt{M}}$

B) $\frac{1}{M}$ D) None of these

Q.48 The pressure of gas is directly proportional to

A) Mean velocity of the molecules

B) Root mean square velocity of the molecules

C) Velocities of individual molecule

D) Mean square velocity of the molecules

Q.49 The temperature of a gas is 0°C. Its root mean square velocity will be doubled at:

A) 273 °C C) 1092 °C

B) 819 °C D) 103 °C

Q.50 The r.m.s velocity of the molecules of an ideal gas at S.T.P is 'v'. The gas is heated at constant volume till the pressure becomes double. The final r.m.s velocity is

A) v C) $\sqrt{2}$v

B) 2v D) $\frac{v}{2}$

Q.51 The mean square velocity of the molecules of an ideal gas at S.T.P is 'v'. The gas is heated at constant volume

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till the pressure becomes double. The final mean square velocity is:

A) v C) $\sqrt{2}$v

B) 2v D) $\frac{v}{2}$

Q.52 The temperature of a gas is increased from 27 ^{o}C to 127 ^{o}C. The ratio of mean K.E at initial to final temperature is:

A) $\frac{10}{9}$ C) $\frac{4}{3}$

B) $\frac{3}{4}$ D) $\frac{9}{16}$

Q.53 The mean kinetic energy of gas molecules at t ^{o}C is directly proportional to:

A) $\sqrt{t}$ C) $\sqrt{t+273}$

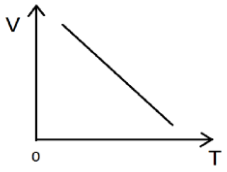
B) $(t+273)$ D) t

Q.54 The density of gas A is four times that of gas B. If the molar mass of gas A is M, then molar mass of gas B is:

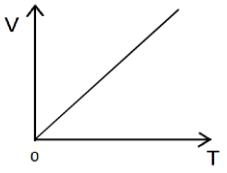
A) 2M C) 4M

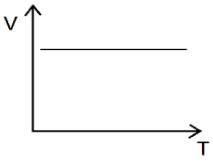
B) $\frac{M}{4}$ D) $\frac{M}{2}$

Q.55 Which one of the following represents correctly the variation of the volume (V) of an ideal gas with temperature (T) under constant pressure conditions?

A) 

C) 

B) 

D) 

Q.56 Which one is correct relation between "°F " and " °C "?

A) $^{\circ}F=\frac{9}{5}{}^{\circ}C+32$ C) $^{\circ}F=\frac{9}{5}(^{\circ}C+32)$

B) $^{\circ}C=(^{\circ}F-32)\frac{5}{9}$ D) Both A and B

Q.57 The temperature at which " °C" and " °F" have same

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values:

A) +40° C) -40°

B) 160° D) -160°

Q.58 The temperature at which " °F" and "kelvin" have same values:

A) 460 C) 340

B) 574 D) 525

Q.59 At constant temperature if the pressure of gas is doubled then its volume becomes:

A) Half C) Remains same

B) Double D) Four times

Q.60 In the general gas equation $PV = nRT$, how many state variable are there?

A) 2 C) 4

B) 3 D) 5

Q.61 Which one of following is not true about the ratio "$\frac{R}{N_A}$"?

A) It is called Boltzmann constant

B) It is called gas constant per mole

C) It is called gas constant per molecule

D) None of these

Q.62 Which one of following is true about ideal gas?

A) Mean K.E is directly proportional to absolute temperature

B) Average speed of gas molecules is not zero

C) Average velocity of gas molecules is zero

D) All of these

Q.63 The average speed of oxygen at STP is:

A) 473 m s^{-1} C) 437 m s^{-1}

B) 493 m s^{-1} D) 461 m s^{-1}

Q.64 Which of following expression is not true?

A) $v_{rms} = \sqrt{\frac{3RT}{M}}$ C) $v_{rms} = \sqrt{\frac{3RT}{N_A m}}$

B) $v_{rms} = \sqrt{\frac{3kT}{m}}$ D) None of these

Q.65 Which one is true expression of mean K.E of a molecule

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of ideal gas?

A) $\frac{3P}{2N_o}$ C) $\frac{3kT}{2}$

B) $\frac{3PV}{2N}$ D) All of these

Q.66 Which of following is correct about internal energy of ideal gas?

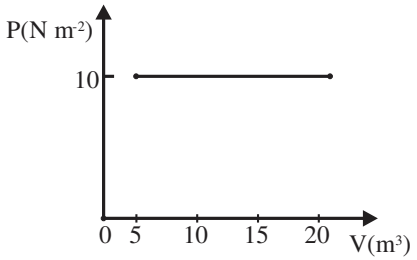
A) It is measure of average translational K.E

B) It is directly proportional to absolute temperature

C) It is a state function

D) All of these

Q.67 The work done during following expansion of:



A) 150 J C) 75 J

B) 100 J D) 200 J

Q.68 First law of thermodynamics is restatement of conservation of:

A) Energy C) Charge

B) Momentum D) Mass

Q.69 Which is correct expression of 1st law of thermodynamics for bicycle pump?

A) $Q=\Delta U+W$ C) $-W=+\Delta U$

B) $Q-\Delta U=W$ D) $\Delta U=Q-W$

Q.70 Which is correct expression of 1st law of thermodynamics for Human metabolism?

A) $\Delta U=Q-W$ C) $+\Delta U=-W$

B) $-\Delta U=+W$ D) None of these

Q.71 The process that occurs at constant temperature is:

A) Isothermal process C) Isochoric process

B) Adiabatic process D) Isobaric process

Q.72 The PV-equation for isothermal process is:

A) $P_1V_1 = P_2V_2$ C) $P = \text{constant}$

B) $P_1V_1^{\gamma} = P_2V_2^{\gamma}$ D) $V = \text{constant}$

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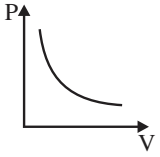
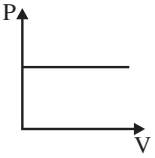
Q.73 **1st law of thermodynamics in case of Adiabatic process is:**

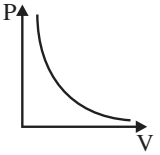
A) $W = -\Delta U$ C) $-Q = +W - \Delta U$

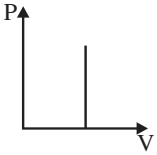
B) $Q = W - \Delta U$ D) $Q - \Delta U = W$

Q.74 **Which one represent Adiabat?**

A) 

C) 

B) 

D) 

Q.75 **The ratio of slope of Adiabat to Isotherm is:**

A) γ C) $\frac{1}{\gamma}$

B) γ^2 D) $\frac{1}{\gamma^2}$

Q.76 **During which process work done is minimum?**

A) Isothermal C) Adiabatic

B) Isochoric D) Isobaric

Q.77 **Which is correct expression?**

A) $C_P - C_V = R, \frac{C_P}{C_V} = \gamma$ C) $C_V = \frac{R}{(\gamma - 1)}$

B) $C_P = \frac{\gamma R}{(\gamma - 1)}$ D) All of these

Q.78 **1st law of thermodynamics in case of Isobaric process is:**

A) $C_P \Delta T = P \Delta V$ C) $C_P \Delta T = C_V \Delta T + P \Delta V$

B) $C_V \Delta T = C_P \Delta T + P \Delta V$ D) None of these

ANSWER KEY (Worksheet-18)							
1	B	21	A	41	D	61	B
2	B	22	C	42	C	62	D
3	D	23	C	43	D	63	D
4	A	24	D	44	C	64	D
5	B	25	D	45	B	65	D
6	A	26	C	46	A	66	D
7	A	27	D	47	C	67	A
8	B	28	C	48	D	68	A
9	B	29	A	49	B	69	C
10	A	30	D	50	C	70	A
11	A	31	D	51	B	71	A
12	A	32	B	52	B	72	A
13	D	33	B	53	B	73	A
14	D	34	D	54	B	74	B
15	D	35	B	55	B	75	A
16	D	36	C	56	D	76	B
17	A	37	D	57	C	77	D
18	D	38	D	58	B	78	C
19	B	39	D	59	A		
20	D	40	D	60	B		

SOLUTIONS

Unit – 6 (WS-18)

Q.1 Answer is "B"

Solution:- General gas equation for n moles is

$PV = nRT$

For one mole of a gas it can be written as:

$PV = RT$

Q.2 Answer is "B"

Solution:- Boltzman constant or gas constant per molecule is given as:

$$K = \frac{R}{N_A} = 1.38 \times 10^{-23}\, J\, K^{-1}$$

Q.3 Answer is "D"

Solution:- At constant temperature,

PV = constant, so graph will be a straight line parallel to P-axis.

Q.4 Answer is "A"

Solution:- Work is not a property of the system or surrounding. Work is a path variable. So work can not characterize the state of matter.

Q.5 Answer is "B"

Solution:- Boyle's law states:

"At constant temperature, the pressure of gas is inversely proportional to its volume."

Q.6 Answer is "A"

Solution:- Expansion causes cooling, when temperature decreases, pressure also decreases.

Q.7 Answer is "A"

Solution:- Put n=1 in general gas equation.

Q.8 Answer is "B"

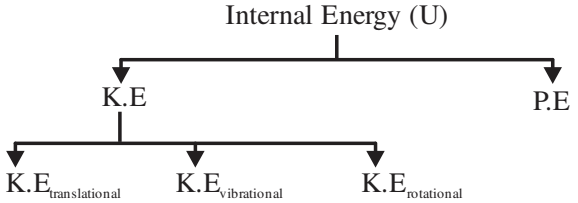
Solution:- $U \propto T$

Q.9 Answer is "B"

Solution:- $$\frac{v_{rms,H_2}}{v_{rms,O_2}} = \sqrt{\frac{\rho_{O_2}}{\rho_{H_2}}}$$

Q.10 Answer is "A"

Solution:- Internal energy of a gas can be described as:



- For ideal gases

$P.E = K.E_{vib} = K.E_{rot} = 0$

So,

$U = K.E_{trans}$

Q.11 Answer is "A"

Solution:- The rms velocity of a gas is:

$$v_{rms} = \sqrt{\frac{3KT}{m}}$$

or it can also be written as:

$$v_{rms} = \sqrt{\frac{3RT}{mN_A}} = \sqrt{\frac{3RT}{M}}$$

$$\left(\therefore M = mN_A\right)$$

Q.12 Answer is "A"

Solution:- Basic property of internal energy

Q.13 Answer is "D"

Solution:- Average velocity = 0

Q.14 Answer is "D"

Solution:- It may be a general process so temperature may rise but it may be an isothermal process as well in which T=constant

Q.15 Answer is "D"

Solution:- Work done is calculated by area under PV graph which is maximum for isobaric process.

Q.16 Answer is "D"

Solution:-

- If system is kept at same state temperature remains same.
- If system undergoes adiabatic process its temperature may rise or fall.

Q.17 Answer is "A"

Solution:- $PV = nRT \Rightarrow P \propto T$

Q.18 Answer is "D"

Solution: The average translational K.E is given as:

$$< K.E >= \frac{3kT}{2} = \frac{3\times 1.38\times 10^{-23}\times 300}{2}$$

$$< K.E >= \frac{3\times 1.38\times 3\times 10^{-21}}{2}\left(\therefore \frac{1.38}{2}\approx 0.7\right)$$

$$< K.E >= 9\times 0.7\times 10^{-21}$$

$$< K.E >= 6.3\times 10^{-21} J$$

Just to simplify calculations we assumed $\frac{1.38}{2} = 0.7$ so, now we'll choose the answer that is closest to 6.3×10^{-21} and smaller than this value. We'll use this technique to simplify calculations.

Q.19 Answer is "B"

Solution:- Usually average speed of gas molecules is found at STP and for gases STP means;

$T = 0\ ^\circ C = 273.16\ K$ and $P = 1\ atm.$

Q.20 Answer is "D"

Solution:- It is determined by temperature

Q.21 Answer is "A"

Solution:- Universal gas constant is related with specific heats as:

$$C_p - C_v = R$$

Q.22 Answer is "C"

Solution:- Use relation; $T_F = \frac{9}{5}T_C + 32$

Q.23 Answer is "C"

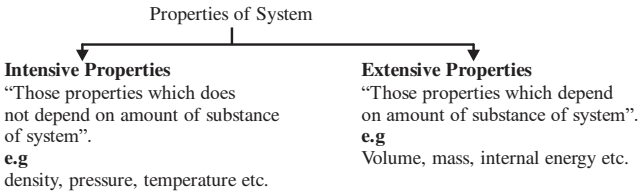
Solution:- Since the volume of gas is kept constant, so;

$$\Delta V = 0$$

$$W = P\Delta V = 0$$

Q.24 Answer is "D"

Solution:-



Note:

Work and heat are neither intensive properties nor extensive properties of system.

Q.25 Answer is "D"

Solution:- Work and heat are not properties of a system. Work and heat are forms of energy in transit. They appear only when there occurs any change in the state of a system or surrounding. They don't exist before and after the change of the state, so they are not system properties.

Q.26 Answer is "C"

Solution:- When we talk about free expansion, it is understood that it is happening in vacuum, where the pressure on the system is zero, so,

$$W = P\Delta V = (0)\Delta V = 0$$

Note:-

Rapid expansion of air from a burst tyre (adiabatic expansion) happens in air, in this case pressure on the system is not zero, so work is done by system on surrounding on the cost of internal energy.

Q.27 Answer is "D"

Solution:- According to kinetic theory of gases, the collisions between the molecules of gas are PERFECTLY ELASTIC not partially elastic.

Q.28 Answer is "C"

Solution:- According to the relation

$$T = \frac{2}{3k} < K.E >$$

$$T \propto < K.E >$$

Temperature of a gas is directly proportional to average K.E.

Q.29 Answer is "A"

Solution:- At very high pressure the forces of attraction starts dominating in real gases and these forces tend to liquify the gas, so volume gets decreased, while in ideal gases no forces of attraction or repulsion are present so their volume at high pressure is more than real gases.

Q.30 Answer is "D"

Solution:- In the ideal gas equation;

$$PV = nRT$$

n=no.of moles, once selected they remain same

R=general gas constant.

P,V,T=describe physical state of gas.

Q.31 Answer is "D"

Solution:- Both heat and work are path variable as their value depends on the path which system follows.

Q.32 Answer is "B"

Solution:- As P=constant, Charles law can be applied which states;

$$V \propto T$$

Where T is in kelvin.

Also;

$$\frac{V_1}{T_1}=\frac{V_2}{T_2} \qquad \left[\begin{array}{l}\therefore T_1=30\ ^\circ C=303\ K\\ V_1=V\\ T_2=?\\ V_2=2V\end{array}\right]$$

$$\frac{V}{303}=\frac{2V}{T_2}$$

$$T_2=606\ K=333\ ^\circ C$$

Q.33 Answer is "B"

Solution:- Data

$$P=600\times10^3\ Pa, V_1=0.01\ \text{m}^3$$

$$W=54\times10^3\ J, \text{V}_2=?$$

$$\text{T}=290\ K$$

Sol:-

$$W=P\Delta V=P\left(V_2-V_1\right)$$

$$54\times10^3=600\times10^3\left(V_2-0.01\right)$$

$$\frac{54}{600}=V_2-0.01$$

$$\frac{54}{6}\times10^{-2}=V_2-0.01$$

$$9\times10^{-2}=V_2-0.01$$

$$V_2=0.09+0.01=0.10\ m^3$$

Q.34 Answer is "D"

Solution:- Data:-

$$A=0.1\ m^2, P=8000\ N\ m^{-2}$$

$$\Delta y=4\ cm=4\times10^{-2}\ m, \text{Q}=42\ \text{J}$$

Sol:-

$$W=P\Delta V=P\left(A\Delta y\right)$$

$$W=8000\times0.1\times4\times10^{-2}$$

$$W=8\times10^3\times1\times10^{-1}\times4\times10^{-2}$$

$$W=32\ J$$

Q.35 Answer is "B"

Solution:- Data

$$A=0.1\ m^2, P=8000\ N\ m^{-2}$$

$$\Delta y=4\ cm=4\times10^{-2}\ m, \text{Q}=42\ \text{J}$$

Sol:-

$$W=P\Delta V=P\left(A\Delta y\right)=32\ J$$

By 1st-law of thermodynamics

$$Q=W+\Delta U$$

$$\Delta U=Q-W=42-32=10$$

$$\Delta U=10\ \text{J}$$

Q.36 Answer is "C"

Solution:- Evidence in favour of kinetic theory of gases is exhibited in diffusion of gases and Brownian motion of smoke particles.

Q.37 Answer is "D"

Solution:- Kinetic theory of gases is based on microscopic approach in which the assumption is that gases are composed of molecules.

Q.38 Answer is "D"

Solution:- P.E is because of attractive or repulsive forces, so for ideal gas it is zero because of no attractive or repulsive force.

Q.39 Answer is "D"

Solution:- Pressure of gas is defined as;

$$P=\frac{F}{A}=\frac{\frac{\Delta P}{\Delta t}}{A}=\frac{\text{Momentum per second}}{Area}$$

Q.40 Answer is "D"

Solution:- See derivation of pressure of Gas

Q.41 Answer is "D"

Solution:-

$$density=\frac{Total\ mass}{Total\ volume}=\frac{mN}{\ell^3}$$

Q.42 Answer is "C"

Solution:- No. of particles colliding with total 6 faces of cube =N

$$\begin{pmatrix} No.\ of\ particles \\ colliding\ with\ one\ face \end{pmatrix} = \frac{N}{6}$$

Q.43 Answer is "D"

Solution:- $v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2}{3}}$

Q.44 Answer is "C"

Solution:- Dalton's law of partial pressure states $P_{mixture} = P_1 + P_2 + ...$

Q.45 Answer is "B"

Solution:- $P = \frac{2}{3}\frac{N}{V} < K.E >$

Here

N < K.E >= average K.E of gas.

<K.E> = average K.E of one molecule of gas

Q.46 Answer is "A"

Solution:- $\frac{v_{rms,1}}{v_{rms,2}} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{M_2}{M_1}}$

Where ρ = density of gas

and M = molar mass of gas

Q.47 Answer is "C"

Solution:- $v_{rms} = \sqrt{\frac{3RT}{M}}$

Q.48 Answer is "D"

Solution:- $P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$

$P \propto < v^2 >$

Q.49 Answer is "B"

Solution:- $\frac{v_{rms,2}}{v_{rms,1}} = \sqrt{\frac{T_2}{T_1}}$ where T_2 and T_1 are temperatures in kelvin

Alternative shortcut to solve this type of problem is:

$T_2 = n^2 T_1$

Where n = the number / factor to which speed at T_2 is greater or smaller than at T_1 for example in this question n=2.

Q.50 Answer is "C"

Solution:- As the pressure of gas is given as:

$$P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$$

$$P = \frac{2}{3}\frac{N}{V}\frac{1}{2}m < v^2 >$$

$P = \text{Constant} < v^2 >$

Taking square root on both sides

$\sqrt{P} = \text{Constant}\sqrt{< v^2 >}$

$\sqrt{P} = \text{Constant}\ v_{rms}$

$\sqrt{P} \propto v_{rms}$

Q.51 Answer is "B"

Solution:- As the pressure of gas is given as:

$$P = \frac{2}{3}\frac{N}{V} < \frac{1}{2}mv^2 >$$

$P \propto < v^2 >$

$< v^2 >$ = mean square velocity = v_{ms}

$P \propto v_{ms}$

Q.52 Answer is "B"

Solution:- $\frac{< K.E >_1}{< K.E >_2} = \frac{T_1}{T_2}$

Q.53 Answer is "B"

Solution:- $T = \frac{2}{3k} < K.E >$

$(t + 273) = \frac{2}{3k} < K.E >$

Q.54 Answer is "B"

Solution:- $\frac{\rho_A}{\rho_B} = \frac{M_A}{M_B}$

Q.55 Answer is "B"

Solution:- $V \propto T$

Q.56 Answer is "D"

Solution:- Temperature conversion formulae

Q.57 Answer is "C"

Solution:- $\frac{^{\circ}C - 0^{\circ}}{100} = \frac{^{\circ}F - 32}{180} = \frac{K - 273}{100}$

Q.58 Answer is "B"

Solution:- $\frac{^{\circ}C - 0^{\circ}}{100} = \frac{^{\circ}F - 32}{180} = \frac{K - 273}{100}$

Q.59 Answer is "A"

Solution:- $P \propto \frac{1}{V}$

Q.60 Answer is "B"

Solution:- P, V and T are state variable

Q.61 Answer is "B"

Solution:- Boltzmann constant /gas constant per molecule is defined as;

$K = \frac{R}{N_A} = 1.38 \times 10^{-23} \text{ J K}^{-1}$

Q.62 Answer is "D"

Solution:- Average velocity of gas molecules is zero but average speed/rms velocity is not zero. Also,

$T = \frac{2}{3k} < K.E >$

$T \propto < K.E >$

Q.63 Answer is "D"

Solution:- Average speed of oxygen at STP is:

$V = 461 \text{ m s}^{-1}$

Average speed of nitrogen at STP is

$V = 493 \text{ m s}^{-1}$

Q.64 Answer is "D"

Solution:- Rms velocity of gas molecules is given as

$v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{mN_A}} = \sqrt{\frac{3RT}{M}}$

Q.65 Answer is "D"

Solution:- $P = \frac{2}{3}\frac{N}{V} < K.E >$

Q.66 Answer is "D"

Solution:- For ideal gas internal energy is equal to average K.E of gas molecules which is directly proportional to absolute temperature.

Q.67 Answer is "A"

Solution:- Find area under graph i.e

$W = \text{Area} = (10)(20 - 5)$

$W = (10)(15) = 150 \text{ J}$

Q.68 Answer is "A"

Solution:- 1st Law of thermodynamics is another statement of law of conservation of energy.

Q.69 Answer is "C"

Solution:- For a bicycle pump Q=0, so,

$Q = W + \Delta U$

$0 = W + \Delta U$

$-W = +\Delta U$

(-W) $\Rightarrow$ Workdone on the system

(ΔU) $\Rightarrow$ Increase in internal energy

Q.70 Answer is "A"

Solution:- Rearrange 1st law of thermodynamics

i.e

$Q = W + \Delta U$

$\Delta U = Q - W$

$(\Delta U) \Rightarrow$ Change in internal energy

(Q) $\Rightarrow$ Energy gained from food

(-W) $\Rightarrow$ Energy dissipated in different process by body

Q.71 Answer is "A"

Solution:-

- Process at constant temperature is called isothermal process
- Process at constant volume is called isochoric/isometric process
- Process at constant pressure is called isobaric process
- Process in which Q=0 is called adiabatic / isentropic process

Q.72 Answer is "A"

Solution:- For isothermal process:

T = constant

So, Boyle's law is applicable i.e

$P_1V_1 = P_2V_2$

Q.73 Answer is "A"

Solution:- As $Q = W + \Delta U$ putting Q=0

$0 = W + \Delta U$

$W = -\Delta U \Rightarrow$ Adiabatic Expansion

$-W = \Delta U \Rightarrow$ Adiabatic Compression

$-\Delta U \Rightarrow$Adiabatic expansion

$\Delta U \Rightarrow$Adiabatic compression

Q.74 Answer is "B"

Solution:- Among "A" and "B" the curve in option B is steeper, so it is adiabat.

Q.75 Answer is "A"

Solution:-

$$(\text{Slope})_{\text{Isotherm}} = \frac{-P}{V}$$

$$(\text{Slope})_{\text{Adiabat}} = -\frac{\gamma P}{V}$$

Taking ratio:

$$\frac{(Slope)_{adiabat}}{(Slope)_{isotherm}} = \gamma$$

Q.76 Answer is "B"

Solution:- For isochoric process $\Delta V = 0$ and $W = P\Delta V = 0$.

Q.77 Answer is "D"

Solution:- $C_P - C_V = R \longrightarrow (1)$

$$\gamma = \frac{C_p}{C_v}$$

$$C_p = \gamma C_v \qquad C_v = \frac{C_p}{\gamma}$$

Put these values after other in (1) and solve.

Q.78 Answer is "C"

Solution:- For isobaric process

$Q_P = W + \Delta U$

$C_P \Delta T = P\Delta V + \Delta U$

$C_P \Delta T = P\Delta V + C_V \Delta T$

STEP

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